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TRADITIONAL KNOWLEDGE

The system of traditional knowledge in the Mediterranean and its classification with reference to different social groupings

Note by the secretariat

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LOCAL AND TRADITIONAL KNOWLEDGE
TO COMBAT DESERTIFICATION

THE SYSTEM OF TRADITIONAL KNOWLEDGE IN THE MEDITERRANEAN AND ITS CLASSIFICATION WITH REFERENCE TO DIFFERENT SOCIAL GROUPINGS

Report prepared for the Secretariat of the Convention to Combat Desertification

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THE SYSTEM OF TRADITIONAL KNOWLEDGE IN THE MEDITERRANEAN AND ITS CLASSIFICATION WITH REFERENCE TO DIFFERENT SOCIAL GROUPINGS[1]

1. Objectives of the study

a) The definition of the characteristics of traditional knowledge;
b) The study of the criteria according to which traditional knowledge should be classified;
c) The drawing up of an inventory of traditional knowledge in the Mediterranean area and indication of the successful techniques;
d) The assessment of the ways in which traditional techniques can be used by adopting modern technologies;
e) Proposals and recommendations.

2. Traditional techniques or local science systems?

During the second Conference of the Parties that was held in Dakar in October 1998 (COP 2), the secretariat of the Convention has brought up for discussion to the Committee on Science and Technology the synthesis of the reports on traditional knowledge drawn up by different countries and by the experts who carried out the missions.

The study (ICCD/COP(2)/CST/5) presents the inventory on traditional knowledge in the form of a list of 78 items of techniques or practices divided into 7 different topics:

- Fight against wind and water erosion (8 items);
- Hydraulic organization for water conservation (14 items);
- Improvement of soil fertility (20 items);
- Vegetation protection (9 items);
- Forestry (5 items);
- Social organization (9 items);
- Architecture and energy (13 items).

The reason why the inventory has been structured this way rises from the need of synthesising a very wide topic that will be subsequently enriched and supplied with graphs on different techniques and procedures, thus representing a useful manual on traditional knowledge.

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[1] This report was originally provided with a graphic part made up of coloured maps, tables and graphs with technical forms of the traditional technologies that have been put forward. The tables can be download from the Web site: **www.laureano.it**

However, the classification, that is based on goals and functions, could impoverish the topic and could not convey the meaning nor understand the way in which traditional techniques work. Traditional and local knowledge is part of a complex system and it cannot consist of a simple list of technical solutions and be limited to a series of different applications varying according to the results to be obtained. Their efficacy depends on the interaction among several factors. They must be carefully taken into account if the success accomplished in history by means of traditional knowledge and its logic are to be understood for a contemporary application.

Each traditional practice is not an expedient to solve a single problem, but it is an elaborated and often a multipurpose system that is part of an integral approach (society, culture and economy) which is strictly linked to an idea of the world based on the careful management of local resources.

A terrace is a way to protect a slope, to reinstate the soil and to harvest water. It works within a social organization and a shared system of values that supports it and that is, in turn, based on it. During flood periods, in dryland areas what seems to be a network of narrow streets is an important system of flood diversion having different functions according to season changes.

The modern technology tries to be immediately efficacious by using the specialization of knowledge managed by dominant structures that are able to mobilize those resources that are external to the environment. In the long and very long period, traditional knowledge proves functional by using a shared knowledge created and handed down by different generations and social practices and uses internal renewable input. Thanks to modern technology it has been possible to excavate pits at high depths by pumping ground water. The results can be rapidly checked but the local resources can be depleted and sometimes, as time goes on, by fishing in fossil water beds, the resources can be completely depleted. On the other hand, traditional knowledge uses meteoric water harvesting systems or surface aquifers by using gravity or by adopting catchment systems that enable the reproduction of the resource and its durability in the long run.

Whereas traditional technological methods use separation and specialization, modern knowledge applies combination and integration. According to the traditional idea, the forest, the agriculture and the town are three items completely separated because they fulfil different needs, such as: wood, food, house. Each item avails itself of a specialized scientific system: forestry, agriculture and town-planning. According to local knowledge, the plant heritage is not artificially separated from the forest that provides commercial wood and from the farming land that provides food (Shiva see page 18). Forests, fields and dwellings are unitary ecological systems. The forest and the other marginal areas which are apparently non productive

areas, like the steppes and the marshlands, provide considerable amount of food and water, fodder and fertilizers for agriculture. It is also possible to live in these marginal areas. The traditional town, in its turn, integrates with agriculture thus replacing, in desert areas, the forest for obtaining fertilizers that are produced by organic wastes of the inhabitants and for the production of the water caught on the roofs of the houses. As a result, the humus produced in the fields gives the soil its colloidal quality which is necessary for building houses in adobe towns. The hole made by excavating the land is used either as a gutter for water, or as a hole for the transformation of dung into humus, or as orchard whose contour is protected by excavation walls. Therefore, the activities are carried out in this feedback cycle where the result of one activity is the basis for the realization of the other. The architecture fulfils this need in every single detail. In Shibam, which is an adobe town located in Yemen, the town-plan is in harmony with the need to collect organic waste separately in two-outlet toilets. These toilets are necessary because they enable to transform the sand into fertile soil.

This principle which is very similar to the functioning of nature where each residue of a system is used by other systems, where the idea of waste or the possibility to resort to external resources do not exist, has allowed the survival of people throughout history. Multipurpose techniques have been successful even in hard times. The collaboration and the symbiosis by reusing what is produced within a system enabled the autopoiesis, the self-reproduction, the self-propulsive development, which does not depend on exogenous or occasional factors.

When this logic is supported by strong cohesion between society, culture and economy, a positive development is obtained in history. The synthesis between traditional knowledge and social systems leads to forms of intensification by appropriately using the resources and entailing positive status changes, thus realizing rural or urban ecosystems. This process enabled the success of important civilizations based on traditional techniques, thus producing important socio-economic results.

The wonderful civilization of Angkor owes its wealth to the excavation of monumental canals or ditches that in the North-East of Thailand surround human settlements with more concentric circles. This is a traditional practice that has been used since prehistory. These works, which actually shape the landscape, are generally referred to as drainage or irrigation systems, although this definition is not comprehensive. As the ditches can be easily crossed, even the defensive reason is not sufficient to explain why tis technique is successfully adopted. Only by understanding their multipurpose use (Liere 1980 p. 269) as water reserves in the cold season, protection against floods during the wet season, symbolic and identification value of the community, is it possible to explain the reason why this practice is successful.

Besides the interaction among environmental, productive, technological and social aspects we should take into consideration both aesthetic and ethic values. The traditional procedure works in harmony with the landscape, thus trying to meet the traditional aesthetic needs. A tool for water harvesting or conduction is not only a technical structure but it is also a beautiful structure. The oases are productive systems but at the same time they are places of contemplation and rest. Likewise in the south of Italy, the small farmlands of the desert are called gardens, thus eliminating the difference between orchards and gardens. The constructions and the methods often have a deep symbolic meaning that draw continuous analogies between technique, art and nature. The water repartition systems in the Sahara desert are reproduced on the patterns of carpets and in women's hairstyle. They are complex symbols linked to life, fertility and generations. Spiritual principles sanctify the rules thus guaranteeing their dissemination. This is the case of the holy woods in Africa that have limited access or of all the taboo goods, that are practices which guarantee forest reinstatement, environmental and soil resources saving as reserve for nature and human communities.

Therefore, the traditional technique is an integral part of a set of links and relationships that is strongly integrated and supported by symbols and meanings. The traditional technique is performed thanks to a cultural structure that is socially shared: it is the system of the local historical science and knowledge.

Therefore, it is wrong to isolate the single technology, which always relates to a context and is not only linked to an environmental situation but also to a precise historic period or to a complex social structure. These remarks are necessary in view of the dissemination, the reproducibility or the reuse of contemporary forms of traditional techniques. Actually, it is not true that a traditional technique always gives positive results in different situations and periods. The "slash and burn agriculture" or the "shifting agriculture" enabled the survival of human groupings for very long period of time in perfect harmony with resources but it can also turn out to be catastrophic if it is applied in a different environmental and demographic context.

The traditional knowledge must not be meant as a set of expedients to be replaced by traditional background, but it must contribute to the formation of a new paradigm. What it is possible to learn from traditional and local knowledge is not a series of miracle-solutions that could be able to act in the same logic of modernity. It is the method on which it is based that can be put forward again by means of modern technologies.

MODERN KNOWLEDGE	*TRADITIONAL KNOWLEDGE*
Specific solution	Multipurpose system
Immediate efficacy	Functionless in the long run
Specialization	Holism
Dominant powers	Autonomy
Separation	Integration
External resources	Internal inputs
Conflicts	Symbiosis
Monoculture	Relationship and complexity
Uniformity	Diversity
Severity	Flexibility
Expensive maintenance	Self-regulation and work intensity
Internationalization	Contextualizing
Waste	Saving
Technicism and rationalism	Symbolism and wealth of meanings
Dependence	Autopoiesis

3. Intensification of resources and socio-cultural groupings

The fact that traditional knowledge is not considered as a simple set of techniques means that they are evaluated in the framework of environmental, productive and cultural conditions of societies. The inventory of technologies, knowledge, traditional and local practices is used as the study on social groupings. They keep the relationship with nature by means of a series of practices to use resources which represent their technological aspect and are integral part of the cultural system.

Thanks to this knowledge, technologies and devices for environmental change, the populations are able to obtain an increasing number of resources from the environment in comparison with the resources that nature offers. Therefore, the advantages increase, thus guaranteeing the best life conditions that can undergo further positive changes. The communities who live in harmony with the resources can endure for very long periods of time. Deep changes can also occur either in longer periods of time or they can be concentrated in more rapid status revolutions that cause the passage from one social grouping to another.

Therefore, the topic of the study ranges from history to the whole humankind knowledge without any constraints of time and space. For these reasons, this inventory does not mean to be comprehensive but it aims at highlighting a system, a grid of theoric reference and an outline of classification within which it will be always possible to introduce new contributions.

The traditional knowledge system is rebuilt according to the common classification of social groupings used in archaeology and anthropology: *hunters-gatherers, farmers-breeders, agro-pastoralists that use metals*. Besides these three categories there are two more synthesis represented by more complex traditional social systems of intensification and integration of knowledge. Within these systems the technologies of previous social groupings seem to be stratified and combined in a diversified way according to different social and environmental situations.

The first synthesis of a complex system is the oasis meant as the artificial formation thanks to a perfect environment knowledge. In the desert the environmental context of aridity is interrupted by specific situations which create niches and micro-environments that can counter to the overall cycle. A shallow depression can collect moisture, a rock can cast a shadow, a seed can thrive. In this way positive feedback can begin: the plant will generate its own protection against the sun's rays, it will concentrate water vapour, attract insects which will produce biological material, it will create the soil which will then nourish it.

Thus, a biological system is created which can use other organisms making their own contribution. A symbiosis is set up, a micro-cosmos is created as the result of co-existence. The peoples inhabiting the Sahara desert use theses processes to create their oases. The origin of an oasis often was a simple palm tree planted in a shallow depression in the soil and surrounded by dead branches protecting it from the sand. Over time, vast cultivated stretches grew along terraced canyons or else green archipelagoes rose up from the sand dunes thanks to diversified and complex water production techniques, land organization and the creation of a microclimate. Though on entirely different scales, the same principle, the *oasis effect* applies: a *virtuous cycle* is established which can run itself and regenerate itself. This process can be used as a pattern that can be applied for all the situations, also for non desert lands, whereby islands of fertility are created and is defined as follows: *an oasis is a human settlement in a harsh geographical situation that use rare resources which are available locally in order to spark off a rising amplification of positive interactions and create a fertile, self-sustaining environmental niche which is in direct contrast with the unfavourable surroundings* (Laureano P. 1988). Therefore, there are adobe oases in the Sahara desert, stone oases in rocky plateaux and sea oases in the isles. Even in rainforest, the settlements of Maya, in Yucatan, can be referred to as an oasis system because they did not have any ground water courses due to special karst environments.

Niches of oasis intensification are found in the whole Mediterranean. These systems are particularly widespread in the southern shore of the Mediterranean, in the southern Euro-Mediterranean part, in the isles and in the peninsulas and in all the situations where there are harsh and changing

climate conditions, with torrential rainfalls in some months of the year and dry seasons. As a result, an accurate management of the water resource, that is not lacking either in lakes or in rivers is necessary as well as technological measures to control its change throughout time.

The following complex system is the *urban ecosystem* that is the oasis model changed into town. This system consists of large caravan-route towns in the desert or urban clusters that are not as small as the oasis model. Irrigated areas are created by using favourable geomorphological situations in given geographic systems. A big capital dominates each unit of landscape: isolated basins in the middle of the desert; large plains among the mountains; oasis along hydrographic networks; crossroads of remote, international and intercontinental routes. However, these ecosystems are also traditional habitats that exploits the resources available, thus becoming important regional historic centres with urban characteristics. This classification enables to follow the continuous process of knowledge gathering and stratification in a chronologic way since the first three social groupings correspond to the passage from the Palaeolithic, the Neolithic, the Metal Age to more complex systems of oases and ecosystems. However, if it is useful for classification purposes it could be misleading to outline a theoric idea. In our pattern, the kinds of social groupings do not represent development phases of human history, but rather are the conditions that characterize precise periods of time and can live together in the same historic periods. In the long run they realize continuity, over-lappings and integrations. The socio-cultural groupings, which dominated the dawn of human history are still present in human groupings that have similar knowledge to those found during the palaeontologic and archaeologic studies. Of course, there are some differences among the communities belonging to the same social grouping of the same historic period.

The kinds of socio-cultural groupings must not be meant as universal characteristics: they change according to the geographical context and to the characteristics of dominant ideas. The distinction and the classification rise from a scientific need that hidden the stratification of technological levels and cultures, the current diversified climate and environmental conditions, the synchronic experiences of humankind and different social patterns. Both the environment and the idea of the world of a community contribute to the establishment and the safeguard of specific characters. Both factors vary continuously in time and from one place to the other, thus creating and preserving the cultural diversity.

3.1 Hunters-Gatherers

Socio-cultural groupings: Hunters-Gatherers
Environmental system: mobility, routes along the ridges, savannah, dissemination all over the Planet

Local and traditional knowledge:
- Hunting and fishing tools, portable multipurpose tools;
- Traps;
- Holders;
- Use of cave-dwellings;
- Use, transport or stoke of the fire;
- Water harvesting in cave-dwellings by water dripping and percolation;
- Food harvesting near the springs, torrents and dried beds of watercourses;
- Salt collection and food conservation;
- Soil sprinkling near the spring by aspersion to facilitate the growth of edible wild plants;
- Stone arrangement and first forms of irrigation;
- Natural rudimental agriculture depending on rainfall;
- Small rough stone "dams" to retain water and excavate streams to divert water towards the margin of the valley;
- Maize-like water traps;
- Role of women in recognizing useful and edible plants;
- "Cultivation" of insects and larvae, capture and killing of small animals;
- Taboo-goods (animals, plants and places) and resource saving;
- Movable "gardens".

3.2 Farmers-Breeders

Socio-Cultural Groupings: Farmers-Breeders
Environmental system: sedentariness, settlement on the plateaux, demographic growth.

Local and traditional knowledge:
- Animal and plant domestication;
- Slash and burn agriculture (shifting agriculture);
- Breeding;
- Fishing;
- Natural forage collection and fire for a better regeneration;
- Use of residues to feed animals;
- Excavation and drainage techniques used in mines;
- Rainwater harvested in pits and cisterns;

- Animal shelter and grain storage;
- Pit courtyard;
- Villages with large ditches to drain the land and harvest water;
- Multipurpose system: the ditches delimitate the area, protect it from water. They are used as cisterns and drinking-troughs; they collect sewage for the formation of humus;
- Adobe architecture and circular stone huts;
- Walled gardens;
- Sabean Agriculture.

3.3 Agro-pastoralists

Socio-Cultural Groupings: Agro-pastoralists
Environmental system: Colonization of the slopes

Local and traditional knowledge:
- Terraces for soil conservation and plants;
- Dry walls;
- Bisse;
- Diversion and control of rainfalls along the slopes;
- Excavation of cave-dwellings for cultural purpose and for diverting waters;
- Use of the principles for moisture condensation;
- Water conservation in jar-like cisterns;
- Tumulus and stone arrangement;
- Devices for the formation of humus;
- Soil fertility improvement;
- Megalithic monuments, tholos, trulli, mounds of stones, cisterns, sheep folds, jazzi;
- Water intakes and canalisations to irrigate by gravity the dry slopes which are situated above the riverbed;
- Salinas;
- Caves;
- Rock-salt mines and metals;
- Nomadism and Transhumance as a way to manage differentiated resources of the territory;
- Threshing-floors - "garden";
- Olive-tree domestication and spreading: fortified and terraced olive-groves;
- Nabataean Agriculture.

3.4 Oasis

Social grouping: Oasis and other forms of agricultural intensification
Environmental system: Creating fertility and good life conditions in a harsh environment

Local and traditional knowledge:

- Symbiosis: different contributions for the realization of the ecosystem (an excavation favours condensation, a plant casts shadow, an insect finds shelter and when it decomposes it produces humus);
- Autopoiesis: realization of a virtuous cycle of reproduction and self-sustainability;
- Important camel nomadism that appropriately manage the rare resources organizing breeding on very large areas;
- Underground dams and realization of "gardens" on the sides of the riverbed;
- Underground catchment systems (foggara, qanat, ...);
- Hydro genesis and use of hidden rainfalls;
- Atmospheric spring, condensators and moisture catchers;
- Systems of formation of artificial dunes (afreg) used for protection
- Systems of clustered or underground habitats;
- Soil formation;
- Horticulture combined with taller plants (Palm tree, Papaia, Banana);
- Walled gardens;
- Palm-tree domestication and spreading;
- Oasis effect under the palm-tree leafage and three-storey agriculture;
- Forms of social solidarity;
- Water corporations and hydraulic law;
- Andalusia agriculture;
- Motselo;
- Floating gardens (Chinanpas Mexico).

3.5 Urban Ecosystems

Socio-cultural groupings: Urban ecosystems
Environmental systems: Oasis town: poles of geographic basins (canyons, large fossil beds, extinct craters, caravan routes and communication corridors) managed in harmony with renewable resources.

Local and Traditional Knowledge:

- Canyon and Gravina settlements: vertical integration of geographic systems: plateaux-slopes-valley;
- Diversion and use of floods for irrigation;

- Integrated use of water catchment systems, condensation, harvesting, canalization and distribution;
- Collection of urban organic waste to obtain fertile soil;
- Dwellings made of traditional materials that are useful for energy saving, water harvesting and recycling;
- Integration of building, consumption and agricultural production cycles;
- Systems of traditional habitats: towns, adobe stone and sea oasis.

4. The application of the model to a typical Mediterranean case study: The "Sassi" of Matera

A typical example of a traditional use of resources in the Mediterranean is represented by the Sassi of Matera and the similar settlements of the Murge plateau until Taranto. The local knowledge system adopted is found in a wide set of situations ranging from the troglodytic dwellings of the Loire valley, in France, to Petra, in Jordan, to the towns carved out of the calcareous rock in Cappadocia, in Turkey, to the underground settlements of Matmata in Tunisia, to the villages along the canyons in Algeria and in Morocco up to Andalusia and Nabataean water farming techniques.

The towns are built along the borders of deep valleys, the Gravine, that have a small water carrying capacity or do not have any. The settlements are not placed on the bottom of the canyon like one could expect if it were to provide water, but on the upper part, along the plateau and its steep slopes. In fact, the resources of the maze-like troglodytic dwellings of the Sassi of Matera and of the other stone towns of the Gravine are the rain and the dew that are harvested in drains and in cave-dwellings (Laureano P. 1995). The time stratification of traditional knowledge according to the classification adopted for social groupings, hunters-gatherers, farmers-breeders, agro-pastoralists shows the progressive determination of a complex system of knowledge and appropriate use of resources until the creation of stone oasis and of the urban ecosystem.

4.1 Hunters-Gatherers (Water harvesting in the cave dwellings by dripping and percolation)

Human beings have settled the area from the Palaeolithic onwards, as evidenced by a number of stone findings in the Grotta dei Pipistrelli (The Cave of Bats) and by an intact skeleton of a hominoid found in a karst pi' near Altamura which has been dated at about 250,000 years old. The Grotta dei Pipistrelli is a natural formation but its structure is made up of a passageway, the entrance of which gives out onto the slope and the other end of which emerges through a karst sink hole onto the plain and is a model for later artificial constructions.

4.2 Farmers-Breeders (Rainwater harvesting in wells and cisterns; villages with large ditches to drain the soil and harvest water; multipurpose system)

During the neolithic age, a number of techniques were developed for digging in the calcareous highland and for harvesting water. Bell-shaped cisterns, huts and small canals were enclosed in deep ditches, forming circles and ellipses and were therefore called entrenched villages. It is nonetheless likely that the ditches were not used for defensive purposes, but rather they were used in neolithic practices of animal husbandry and farming. An analysis of aerial photographs showing where vegetation grew more thickly also show drainage systems (Tiné 1983), that is used for water harvesting or humus collection, and the maze-like systems called *corral* that were necessary for agricultural and animal grazing. The recent excavation of the neolithic complex of Casale del Dolce near Anagni underpins this hypothesis (Zarattini and Petrassi 1999).

4.3 Agro-Pastoralists (Cave excavation for worshipping purpose and for intercepting water; pit courtyards; terracing for soil conservation and plants; dry walls; megalithic monuments; moisture condensators; barrows and stone arrangement)

The Age of Metals provided new tools, which made it easier to excavate caves and pits. As the environment deteriorated, these caves became ever more attractive as human dwellings. In fact, the progressive loss of the vegetation cover left the surface villages without shelter, left the land unprotected, thus causing a shortage of wood for building and heating purposes. The climate ranged from freezing winters to broiling summers.

The absolute lack in water in the rivers or on the slope made it necessary to harvest meteoric water in underground cisterns. An increasing popular form of dwelling was the pit courtyard, which had been developed during the neolithic age subsequent to the development of excavation techniques where tunnels radiated out from a central shaft.

This dwelling model also arose in remote areas such as Matmata, in Tunisia and on the dry plains of China and was the origin of the courtyard dwelling used by the Sumerians, both in antiquity and during the Islamic era. An excavated house near the neolithic site of Murgia Timone, across from the Sassi of Matera, proves just how effective this type of construction is. The house is rectangular in shape like the megaron of Crete and is divided into three spaces made up of two open rooms and a third underground room. The courtyard is used as a water reservoir, it is an open and sunny space, which is protected by its walls and which can be used for the preparation of the food. At the opposite end is a garden, that is used for waste and as a compost heap, which has been carved out of the rock. The garden is

absolutely necessary given the poor soil and the need to protect plants. The caves keep a constant temperature throughout the whole year and are ideal shelters for men and animals, for the storage of grains and water conservation.

It is interesting to remark that after the structure was discovered and freed of sediments, the underground part of the cistern soon filled up with water, even though there had been no rainfall. Therefore, the system started working again using capillary infiltration and condensation.

Even the barrows of the Bronze Age took their shape from water harvesting practices, both functionally and ritually. The barrows were basically a double circle through which ran a corridor with a room excavated down the centre. What is interesting to notice is that these structures were introduced along the excavation of the archaic neolithic walls, which had been abandoned when the buildings were constructed, but which can still be used as moisture diversion systems.

What has been found in Matera is quite similar to prehistoric structures made up of barrows and underground rooms in the Sahara desert. Actually, these are solar tombs made up of concentric circles around the barrow. They could also be ancient methods for the collection of moisture and dew and could belong to cults devoted to the practice of water harvesting.

Similar interpretations could be made of the dry stone structures spread throughout the dry lands of Apulia where stone mounds harvest the night dew thus replenishing the soil with moisture. Indeed, the roots of centuries-old olive trees all point to the low walls that are a staple of the farmland. The walls, the barrows, the "trulli" and the mounds of calcareous rock called "specchie" are all structures of water condensation and conservation. These structures carry out their tasks during the day and at night. In the broiling sun, the wind carries traces of moisture which seeps into the interstices of the stone mounds, whose internal temperature is lower than the outside temperature because it is not exposed to the sun and because it has an underground chamber. The decrease in temperature causes the condensation of drops that fall into the cavity. That same water accumulates and provides further moisture and coolness by amplifying the efficiency of the condensation chamber. Overnight, the process is reversed and condensation occurs externally so that dew settles on the surface; the dew slides into the interstices and is harvested in the underground chamber.

4.4 *Stone Oases (Canyon and Gravina settlement: vertical integration of the systems; terracing, realization of ecosystems; dwellings built in traditional materials for energy saving, water harvesting and recycling)*

By developing the original prehistoric techniques, an adapted habitat system that uses the combination of different water production techniques: catchment, distillation and condensation is carried out in the Sassi of Matera. During the torrential rainfalls, the terracing and the water collection systems protect the slopes from erosion and gravity pulls the water down towards the cisterns in the caves. During dry spells, the dug out caves suck out the moisture in the air at night: the moisture condenses in the final underground cistern, which is always full even if it is not connected to outside canals or ducts. The result is a multitude of underground storeys topped by long tunnels, which lead downward underground. Their slope allows the sun's rays to penetrate down to the bottom when heat is most necessary. In winter, the sun's rays are more oblique and can penetrate the underground areas. During the warm season, when the sun is at its zenith, it shines only on the entrance to the underground caves, which thus remain fresh and humid.

We know of up to ten storeys of caves one atop the other, with dozens of bell-shaped cisterns all connected to each other by means of canals and water filter systems Like in the Sahara oasis the system of local knowledge enables, in a situation without water resources, to realize good living conditions thanks to the appropriate use of techniques and to their perfect interaction with the environment.

4.5 *The Urban Ecosystem*

The Medieval monasticism contributed to this archaic texture. The hermitages, the parish churches, the farmhouses that are located in check points of hydraulic works represent the poles of the urban growth process. The two main drainage systems called "grabiglioni" that provide tillable land and humus by sewage collection are surrounded by two urban sections called Sasso Caveoso and Sasso Barisano.

In the middle there is the Civita, the fortified acropolis that represents the ancient shelter in case of danger where the Cathedral was built. At the foot of the plateau where there are large cisterns and ditches as well as rupestral silos for grain storage there are the craftsman's workshops.

The vertical structure of the town allows the use of gravity for water distribution and protects from wind blowing on the plateau. Matera boasts hundreds of rock-hewn churches, which are decorated with beautiful Byzantine frescoes. The churches can also be found on the plateau with sculptured

tufa-stone monumental facades belonging to the medieval, classic or baroque style. However, the whole arrangement of narrow streets, stairs and underground passages continues to follow the ancient urban hydraulic system, Therefore, it is still possible to understand the urban texture of the Sassi of Matera starting from the original texture of the underground areas, of the cisterns and of the terraced gardens as well as from that system of traditional knowledge that allowed an increasing use of resources without depleting them.

5. The system of traditional knowledge in the Mediterranean area

Three sides of the Mediterranean basin are connected with areas where humankind had to cope with dryland areas; its isles are completely lacking in underground or ground water where complex civilizations developed and even in its more northern areas it undergoes a changing and catastrophic environment. Therefore, most of the traditional techniques relative to the water organization for water harvesting, conservation and diversion are widespread as well as the systems of slope protection and the creation of soil that have different characteristics according to the environment. In southern Italy and in Spain there are also systems like for example underground drainage tunnels that are common in oasis towns, in North Africa and in the Eastern World that have been handed down by Islamic civilization or by more ancient civilizations.

The several water saving techniques used by the *Nabataean agriculture*, the condensation caves and pits, the stone arrangement for rainfall harvesting, the underground dams are not only widespread in the Negev desert but also in the whole Mediterranean area. In Petra (Jordan) they present their urban ecosystem synthesis but they can be also found in Tunisia, in Lybia and in southern Italy and in particular in the isles thanks to the influence of prehistoric or widespread traditions imported by current exchanges. The techniques of *Andalusia agriculture* in Spain are widely represented because of the influence of the Islamic civilization. In the isle of Ibiza there is a similar irrigation practice called feixes designed according to an ingenious hydraulic organization. The fields are divided into long and narrow rectangular plots by means of a network of canals having the twofold function of draining the water in excess, thus collecting and saving it and of irrigating the fields during drought seasons. In fact, if these works were not carried out it would be a swampy area in some seasons and arid or flooded by sea water in other seasons. In this way, it is possible to carry out a self-regulating process which allows to practice intensive cultivation of both marshlands and arid lands. Open canals are about one-metre deep and flow at a lower level than the plots of land thus keeping them dry. The land excavated for building the canals is used to raise the level of the cultivated land. During hot seasons when the land undergoes high evaporation, the plots absorb the necessary quantity of moisture directly from the subsoil and from the walls of the canals by osmosis and

capillarity. The process is then fostered by further underground canalisations excavated in the plots. These underground canals are built with porous stones and pine-tree branches covered with a layer of Posidonia algae collected along the coast. This method ensures the good running water piping and at the same time it allows to obtain a certain level of permeability, in order to give the land the quantity of water necessary to keep it humid. Therefore, the irrigation is carried out from the subsoil directly to the plant roots. This technique enables to save water that would be lost because of evaporation by using open irrigation methods.

Traditional techniques are not only adopted in the southern shore of the Mediterranean basin and in the southern areas of the European side but also in northern areas like in France and even in the mountains of Switzerland where particular geomorphologic conditions bring about aridity conditions. This situation is due to the direction of the mountain slopes according to the dominant winds that give out all their moisture when they go up the slopes. Once they have overcome the peak, they beat the slope downhill with dry high-pressure winds that disperses the clouds. This is the phenomenon of the Piedmont desert that in Swiss conditions creates valleys characterized by drought and aridity. These sites of the Valais region and of the province of Sion are characterized by green rangelands and a rich vineyard cultivation. The landscape is not the result of natural condition, but of a wise use of a traditional technique that is called *bisse*. These are wood diversion systems that can also be cut in the rock and extend in the high mountains, the sources of the streams up to the permanent glaciers. They extend for many kilometres with minimum slopes along the steep contours keeping a high altitude to divert the waters upstream the natural running riverbed in order to irrigate the remote valleys, that otherwise would be lacking in water, by using only the gravity. The system is supported by a social cohesion, by corporations and waterworks companies similar to those that manage the Andalusia agriculture or the Saharan drainage tunnels. Like in North Africa and in Spain, it produces a particular kind of landscape where the location of the settling is characterized by the texture and by the outlets of the bisse canals.

The most widespread system characteristic of the Mediterranean area is the terracing system that can be found in the Middle East, in Greece, in Italy and Portugal. This system represents a real element of landscape building especially when it is combined with olive tree or vineyard cultivation. The slopes and the hills of northern Mediterranean have resisted to erosion and their shape results from this titanic and long-lasting work. Besides the dry walls, the mounds of stones (specchie), the tholos architectures (trulli), they represent the typical landscape of Apulia in southern Italy. On the other hand, in central and northern Italy with the terraced slopes of Amalfi and of the Cinque Terre in Liguria they create beautiful and traditional urban ecosystems. The Sardinia and the isle of Ibiza boast systems of fields protected by dry walls that are called "tanka", a name

deriving from an ancient Mediterranean topononym.

The majority of the ancient Mediterranean sites follows the terracing and the hydraulic systems. These sites adopt the techniques of rainfall harvesting, protected vegetable gardens, the use of organic waste for the creation of humus, the methods of passive architecture and of climate control for food storage and for energy saving as well as the practices of recycling productive and food residues. The aesthetic qualities, the beauty of natural materials, the comfort of architecture and spaces, the organic relationship with the landscape that these ancient towns boast are especially due to the intrinsic qualities of traditional techniques and to the search for symbiosis and harmony intrinsic to local knowledge.

The survival of the poor archaic societies of the whole Mediterranean areas depends on the accurate and economical management of natural resources. The close link between traditional farming techniques and settlements make the traditional historic centres a fundamental element for environmental safeguard. In the Mediterranean area, which is characterized by intensive historical settlements, each part of the environment is not only the result of natural process, but rather represents a cultural landscape where historical centres are the crystallization of knowledge appropriate to the correct environmental management and maintenance.

6. Crisis of the traditional historic centres, desertification and degradation of the Mediterranean land

When the balance between resources and their productive use, painstakingly maintained over the centuries, is lost, then the urban ecosystem collapses and sets off a process of deterioration of the hinterland as well. In the Mediterranean basin and in its islands and peninsulas, in Syria, Lebanon, Mesopotamia, Palestine, Arabia and Northern Africa, the sites of the most ancient civilizations, where archaeological excavations brought to light cities which were once surrounded by immense greenery, with fertile fields and thriving gardens, are now abandoned and buried in sand. For three thousand years now, the process of desertification has marched onwards; it has worsened during the industrial age and has reached catastrophic proportions over the last fifty years.

This continuous natural deterioration is not due to natural and climatic conditions, but rather is due to indiscriminate pressures being brought to bear on natural resources. In developed countries, the traditional models of life, of production and of consumption have been cast aside in favour of a system, which totally depletes local resources; this fosters overgrowth of the developed areas by means of massive recourse to external resources, first from the hinterland and then from more and more remote areas. Thus, the entire planet is involved in this mechanism of destruction of our plant

heritage and our landscapes and that chain of transmission of knowledge telling how to deal with environment having been handed down from generation to generation over thousands of years is broken. This destruction cause the end of our capability of maintaining and managing lands whose balanced and harmonious arrangement is the result of labour and culture.

To the urbanization of new areas corresponds the abandonment of ancient centres with the loss of territories that are able to correctly manage the environment. As a result, a physical and social desertification process occurs. The architectural degradation, the slope erosion, the coast soil degradation bring about the depletion of human resources. Migration, the loss of identity and value are socio-cultural aspects of desertification caused by the loss of traditional knowledge.

In modern societies the goods necessary to survival are supplied by world trade and globalization. Both valuable goods and consumer goods and often the food itself come from very remote places. Also in small-scale societies there is an exchange of food and materials, although the resources enabling to live, the most part of hunting products and cultivation are taken by the nearest places. This happens in societies living on local means. The crisis of this model led to a change of humankind that from protector of the environment has changed into wrecker of the environment.

The modern urban areas contribute to the desertification process either in a direct or in an indirect way. In the former case the massive urbanization process itself is desertification because of the presence of constructions on very large natural areas; it is indirect because it occurs through the absorption and the destruction of natural resources in high-demographic areas.

This close relationship between urbanization and desertification can be found in both non industrialized and in developed countries. In Africa and in the Sahel areas where desertification is more severe, the degradation process has started and it extends from areas undergoing a modern and rapid urbanization process that deplete the surrounding territories in order to meet their needs. In the Mediterranean the development of the desertification process is in direct relationship with the crisis of historic urban centres where the traditional arrangement of the landscape made up of natural houses built with a low consumption of resources has been cast aside in favour of a model based on the massive building, energy waste and environment pollution. The increase of urban centres, the increase of produces demand and the consumer goods cause the abandonment of traditional farming systems and the introduction of new methods and agricultural policies based on mono-cropping. The uprooting, the lost or the redefinition of elderly people or women's roles who own the knowledge entail the loss of management capabilities as for resources and traditional

knowledge.

7. Recommendations: The traditional model for a new technological paradigm

The populations of the regions that mainly undergo desertification and degradation and the knowledge they gathered represent an important resource because the local know-how that was improved in the harshest environmental conditions and the existence of intact ancient structures are valuable heritage on which new models of sustainability should be shaped.

The Mediterranean countries play a key role as they represent the link between the most affected areas and developed economies. The historic settlements, the traditional landscape, the local knowledge offer a wide range of solutions to be safeguarded and that can be reused, adjusted and renewed thanks to modern technology.

In reusing them the specific procedure is not important, but rather the logic they bear must fulfil the following principles:

- The enhancement of local resources;
- The ability in local management;
- Low costs that can be spent at a local level;
- The preference for a high quantity of labour force rather than capitals;
- The close relationship with the environment;
- The production cycles and consumption that mutually integrate ;
- The propensity towards zero emissions, which means that every activity can feed another one;
- The self-enhancement and the autopoiesis (self-regeneration);
- A multipurpose system and the interrelationship between technological results, cultural and aesthetic values;
- The accurate resource management;
- The place and energy saving;
- The ecosystem management;
- The integrated project.

In southern Italy traditional sites like Matera were completely abandoned in the 50s and 60s because they were considered as ancient places. Nowadays, they have been restored and repopulated by using traditional and local materials aiming to save energy, harvesting rainfall in cisterns and recycling the wastes. The enhancement process has started with the creation of a new paradigm: to use places that once were symbol of poverty and famine like leisure-time areas and models for the future.

The abandoned slopes that were affected by soil erosion and degradation have been reinstated with dry walls and terracing systems. The works that are being carried out by employing a large number of labour force make use of the ancient knowledge and perform the consolidation of the slopes by creating, at the same time, gardens for the population and cultural areas. Therefore, these projects also realizes tourist attractions bringing additional benefits to the population. The traditional systems are archaeologically, historically and anthropologically interesting, thus adding a cultural value that produces other kinds of wealth. This process can be applied in the whole Mediterranean from the Casbah and the Medinas of North Africa to the Middle East traditional systems.

According to the logic of the traditional knowledge system the new model of environmental management to combat desertification and the soil degradation in the Mediterranean should be based on the following guidelines:

a) In the rural areas agriculture shall not be considered as a simple production system but as a necessary action to maintain the soil;

b) In urban areas environment and town shall integrate and action plans shall be carried out in order to realize a sustainable human settlement and the management of the town as an ecosystem.

The programmes must address innovative actions concerning the soil, water and energy management. In particular it is necessary:

- To use, in a different way, those funds that can cause the destruction of local knowledge, fires, soil degradation and dangerous landscape changes;
- To foster the traditional systems of water production, harvesting and distribution;
- To foster traditional practices for integrated cycle production organization;
- To encourage the programmes of autopoiesis and sustainability of the urban system;
- To foster the systems of integration among the segments of the urban cycles (production, consumption and wastes);
- To involve the population by highlighting the roles of elderly people, women, children and marginal strata of society establishing territorial networks between municipalities, territorial pacts, communities and parks.

New forms and solutions of local knowledge and traditional territorial arrangement shall be put forward again to safeguard and keep the quality of the typical Mediterranean landscape in order to:

a) Play a new global role that can be adopted in those traditional rural systems aiming at soil conservation and resource saving. These activities can be sustainable thanks to the integration with other economies like cultural tourism, archaeology and the use of the environment. As a result, the change of farming methods, desertification factors and the reinstatement of those natural areas that have been upheaved by industrial agriculture can be put forward;

b) Adopt new integrated production cycles, consumption and recycling in urban areas with the enhancement of ancient centres and the use of traditional building techniques for new constructions, the proposal of new quarters based on the saving and appropriate use of resources, the environment reinstatement of areas undergoing urban or industrial desertification;

c) Draw up new programmes of territorial arrangement that take into consideration the aesthetic, cultural and economic values of the landscape meant as a typical quality of the Mediterranean area in general and of the Italian one in particular. This landscape is the result of the millenary relationship between man and nature aiming at the consolidation of its aspect through the characterization of the typical elements and the innovative reuse of the traditional logic by soil enrichment, aquifer reinstatement and resource saving.

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